COMPUTER-BASED INSTRUMENTATION FOR PRESSURE INSTRUMENT USING VISUAL BASIC APPLICATION

MOHD AIZAT FAIZ BIN MOHD YAZID

UNIVERSITI MALAYSIA PAHANG

To my beloved father, Tn. Hj Mohd Yazid bin Ibrahim and my beloved mother, Pn. Hjh. Hasnah bt Juhari,

Who always pray for me and give me courage to finish this thesis.

And also to those people who have guided and inspired me throughout my journey.

Thank you for the supports and advices that have been given.

COMPUTER-BASED INSTRUMENTATION FOR PRESSURE INSTRUMENT USING VISUAL BASIC APPLICATION

MOHD AIZAT FAIZ BIN MOHD YAZID

This thesis is submitted as partial fulfillment of the requirements for the award of the Bachelor of Electrical Engineering (Hons.) (Electronics)

Faculty of Electrical & Electronics Engineering
Universiti Malaysia Pahang

NOVEMBER 2008

Signature : _____

Author : MOHD AIZAT FAIZ BIN MOHD YAZID

Date : 10 NOVEMBER 2008

ACKNOWLEDGEMENT

Firstly, I would like to thank to my family especially to Tn. Hj. Mohd Yazid bin Ibrahim and Pn. Hjh. Hasnah bt Juhari for their fully support through all this year I have been in Universiti Malaysia Pahang (UMP). Special thanks to my very supportive supervisor, Cik Najidah Hambali and Mr. Mohd Anwar Zawawi. This thesis could not have been written without their advice and support throughout my final year project.

Also I would like to thanks to Mr. Mohamad Hamka Embong, Mr. Mohd Salmizan bin Mohd. Zain and Pn. Siti Murzalina bt Sh Murad for their patient dealing with my behavior in finishing this project.

Last but not least, I would like to thanks to all my friends especially to my classmates that helping me directly or indirectly in this project. Without their support and help, this project maybe would not ne success.

ABSTRACT

Generally, the project is about the implementation Graphical User Interface (GUI) of Visual Basic on pressure measurement. The focus on my project is to develop an interface of instrumentation systems for pressure measurement and to integrate the pressure transmitter to software system. This project can be separated into 2 parts which are software and hardware. Using Visual Basic 2008 as software, I develop the GUI so that it can be used for academic purpose especially in laboratory for BEE 4632 Industrial instrumentation subject. This software can be integrated with pressure transmitter using DAQ Board. In my case, I used Advantech USB-47I6 DAQ Boards because it used USB port as connector from instrument to computer. This DAQ Board is easy to use because it comes with installation for plug and play function, English version manual and Device Manager. For instrument, I used Differential Pressure Transmitter. User needs to key in minimum and maximum MSU applied and minimum and maximum Desired UUT in Data Page tab before further to get the actual UUT. After run 3 times of experiment and completing the table, user can calculate the average and output error. Then they can continue to get an average and output error percentage curve in Graph Page tab. Implementation of GUI to this instrumentation system can help to increase the efficiency in calculating the output data.

ABSTRAK

Secara amnya, projek ini adalah untuk menggunakan Antaramuka Grafik Pengguna dari aplikasi Visual Basic kepada pengukuran tekanan. Fokus projek ini adalah untuk membina antaramuka sistem instumentasi bagi pengukuran tekanan dan mengaplikasikan peranti tekanan ke sistem perisian. Projek ini dibahagikan kepada dua bahagian iaitu perisian dan perkakas. Menggunakan Visual Basic, Antaramuka Grafik Pengguna dibina supaya ianya boleh digunakan untuk kegunaan pelajaran terutamanya di makmal untuk subjek BEE 4632 Industrial Instrumentation. Perisian ini boleh dihubungkan kepada peranti tekanan menggunakan papan DAQ. Papan DAQ yang akan digunakan menawarkan kemudahan USB. Ini membolehkan papan DAQ ini digunakan secara Pasang dan Guna. Untuk perkakas, Peranti Perbezaan Tekanan digunakan. Pengguna perlu memasukkan minimum dan maksimum data bagi MSU dan UUT di dalam tab data sebelum boleh mendapatkan bacaan sebenar UUT dari eksperimen. Selepas 3 kali percubaan dan melengkapkan jadual, pengguna boleh mengira Ralat dan purata. Selepas kedua-dua bacaan diperolehi, langkah seterusnya adalah mendapatkan graf bagi purata dan ralat di dalam tab graf. Penggunaan Antaramuka Grafik Pengguna ini boleh meningkatkan ketepatan didalam pengiraan data keluar.

TABLES OF CONTENTS

LIST OF TABLE

LIST OF FIGURE

CHAPTER 1

INTRODUCTION

1.1 Background

Pressure measurement is one of the syllabuses in BEE4632 Industrial Instrumentation subject in Electrical & Electronics fields. This topic can help student to understand more about the basic principles of pressure transmitter in pressure instrumentation. This will need student to demonstrate the procedure of instrument calibration and apply draft calibration of instrument.

In order to help student in studying the pressure instrumentation in more comprehensive ways, the combination of the instrument (Pressure Instrument), hardware (Data Acquisition Module), and software (Visual Basic interface) can help student to understand more compared to only using instrument.

The interface in Visual Basic can be applied in laboratory for this subject in learning process so that the time for the experiment can be reduced.

1.2 Objectives

The objective of this project is to:

i) Understands the basic measurement principles of pressure transmitter

As a requirement in BEE 4632 Industrial Instrumentation, pressure transmitter is one of the syllabuses in this subject. By understand the basic principle of pressure transmitter, it can help student to proceed on higher level of pressure instrument.

ii) Integrate the pressure transmitter to software system using DAQ Card

To archive the objective of this project, integration between hardware and software is one of important element to be done. By successfully done this, it can help student to manipulate data to get various output using software.

iii) Build interface using Visual Basic and used it to get the data such as uncertainty evaluation.

Student can used this interface to insert the data automatically from hardware but it also can be insert manually if the integration against hardware and software cannot be done.

1.3 Scope

This project actually concentrates on how to use the pressure instrumentation and use Visual Basic to get the output such as uncertainty evaluation.

i. Implementation and simulation of the pressure instrument.

Pressure instrument that will be used for this project is EJX110A Yokogawa Differential Pressure Transmitter with Ametek Hand Pump T-740, Yokogawa Digital Manometer MT220. As for reference, the HART 375 Field Communicator will be applied.

ii. Design the interface using Visual Basic and used it as software.

Visual Basic 2008 Express Edition will be used because it compatible to this project compared to Visual Basic.net, or Visual Basic 6.0

iii. Build the hardware as connection between instrument and software.

As for bridge between instrument and software, the DAQ is the best choice compared to ADC or microcontroller. This is because DAQ will show the data in real time.

iv. Programming and analyzing the software to get the data and study analysis.

Using the interface from Visual Basic, the data can be used to analyzed and calculate to get the output such as uncertainty, percentage of error in EJX110A, graph of error and other.

1.4 Problem Statement

Lack of time is the problems to student during perform the pressure instrumentation experiments in lab. This occurs because they need to get the output such as plotted graph manually before they can discuss about the curve. To help reducing the time, Graphic User Interface (GUI) using Visual Basic need to be applied to this pressure instrumentation experiment.

1.5 Methodology

In this project, there are three main parts which is;

i. Pressure Instrumentation - Differential pressure transmitter is used in this project.

ii. Visual Basic - Build interface to analyze the output and get various data.

iii. Data Acquisition Card (DAQ) - Determine the best configuration of DAQ to connect the instrument and computer.

The testing includes;

i. Connect the equipment which includes digital manometer MT220, 2793 resistance box, Differential Pressure Transmitter EJX110A, test gauge, HART 375 Field Communicator and Ametek Hand Pump T-740.

ii. Plot the average output curve for EJX110A against the MSU applied value.

iii. Plot the output error curve for EJX110A against the MSU applied value

iv. Comment the curve.

V. Calibration of EJX110A using HART 375 Field Communicator.

1.6 Thesis Outline

Chapter 1: Introduction

This chapter gives the introduction to the project, objectives, scope of works and methodology taken. It also describes briefly the hardware and software used in this project.

Chapter 2: Literature review

This chapter covers the literature review of the basic pressure theory, visual basic programming language and data acquisition module that being used in this project.

Chapter 3: System Design

This chapter explains about the system design which include hardware and software design. In hardware design, it explains about the connection of the pressure instrument and the data acquisition module. Visual basic programming explained under software design in this chapter.

Chapter 4: Result

The results are determined through the experiment of pressure calibration.

Chapter 5: Conclusion & Recommendations

This chapter will include the conclusion for this project. Some recommendations will be add in this chapter for future improvements.

CHAPTER 2

LITERATURE REVIEW

2.1 Pressure Instrument

Pressure is the force over an area applied to an object in a direction perpendicular to the surface. Gauge pressure is the pressure relative to the local atmospheric or ambient pressure. Pressure is an effect which occurs when a *force* is applied on a surface. The symbol of pressure is *p* (lower case). The upper case *P* is better reserved for power. The SI unit for pressure is the Pascal (Pa), equal to one Newton per square meter (N-m^{-2} or kg $m^{-2}s^{-2}$**).** This special name for the unit was added in 1971; before that, pressure in SI was expressed simply as N/m2.

Several types of pressure are;

i) Sealed Pressure
- Atmosphere pressure, pressure on earth surface - Fixed (14.7 psi@ 101.36 kPa)

ii) Absolute Pressure
- Exerted by fluid
- Pressure measured with respect to the vacuum (psis) @ (kPa) use 'a' n `g' when referencing the pressure to absolute and gauge

iii) Vacuum Gauges
- Pressure below atmosphere

iv) Gauge Pressure

- Pressure measured with respect to atmosphere pressure (psig @ kPa)

v) Differential Pressure

- Pressured measured with respect to the other (one pressured is fixed, the other is measured)

For this project, the differential pressure will be use as an instrument.

2.2 Visual Basic 2008 Express Edition

Microsoft Visual Studio Express is a set of freeware integrated development environments (IDE) developed by Microsoft that are lightweight versions of the Microsoft Visual Studio 2008 product line. The idea of express editions, according to Microsoft, is to provide a streamlined, easy-to-use and easy-to-learn **IDEs** for less serious users, such as hobbyists and students. The final versions were released on November 19, 2007. In line with popular demand since the Visual Studio 2005 Express Editions, these editions will always remain free-of-charge.

Despite the fact that it is a stripped-down version of Visual Studio, some improvements were made upon Visual Basic 2008 from Visual Basic 2005. Visual Basic 2008 Express includes the following improvements over Visual Basic 2005 Express:

- Includes the visual Windows Presentation Foundation designer codenamed "Cider"
- Debugs at runtime
- Better IntelliSense support
- Fixes common spelling errors
- Corrects most invalid syntax

- Provides suggestions to class names when specified classes are not found

The Express Edition has the following limitations:

- No IDE support for databases other than SQL Server Express and Microsoft Access
- No support for Web Applications with ASP.NET (this can instead be done with Visual Web Developer Express, though the non-Express version of Visual Studio allows both web and windows applications from the same IDE)
- No support for developing for mobile devices (no templates or emulator)
- No Crystal Reports
- Fewer project templates (e.g. Windows services template, Excel Workbook template)
- Limited options for debugging and breakpoints.
- No support for creating Windows Services

2.3 Advantech USB-4716 Data Acquisition Module (DAQ)

Data acquisition is the process of gathering or generating information in an automated fashion from analog and digital measurement sources such as sensors and devices under test. Data acquisition systems (DAS) interface between the real world of physical parameters which are analog, and the artificial world of digital computation and control. With current emphasis on digital systems, the interfacing function has become an important one; digital systems are used widely because complex circuits are low cost, accurate, and relatively simple to

implement. In addition, there is rapid growth in the use of microcomputers to perform difficult digital control and measurement functions.

Computerized feedback control systems are used in many different industries today in order to achieve greater productivity in our modern industrial society. Industries that presently employ such automatic systems include steel making, food processing, paper production, oil refining, chemical manufacturing, textile production, cement manufacturing, and others. The devices that perform the interfacing function between analog and digital worlds are analog-to-digital (A/D) and digital-to-analog (D/A) converters, which together are known as data converters.

CHAPTER 3

SYSTEM DESIGN

3.1 Hardware

3. 1.1 Pressure Instrument

Instrument parts as in figure below consist of Ametek Hand Pump T-740, Yokogawa Digital Manometer MT220, 2793 Decade Resistance Box, Yokogawa Differential Pressure Transmitter EJX110A, Test Gauge and HART 375 Field Communicator. The Ametek Hand Pump will give pressure as an input to Yokogawa Differential Pressure Transmitter. This transmitter will convert the input signal into current value and send to Digital Manometer. Hart 375 Field Communicator will be used as a reference to the system. This communicator also can be used to calibrate the EJX I I0A pressure transmitter.

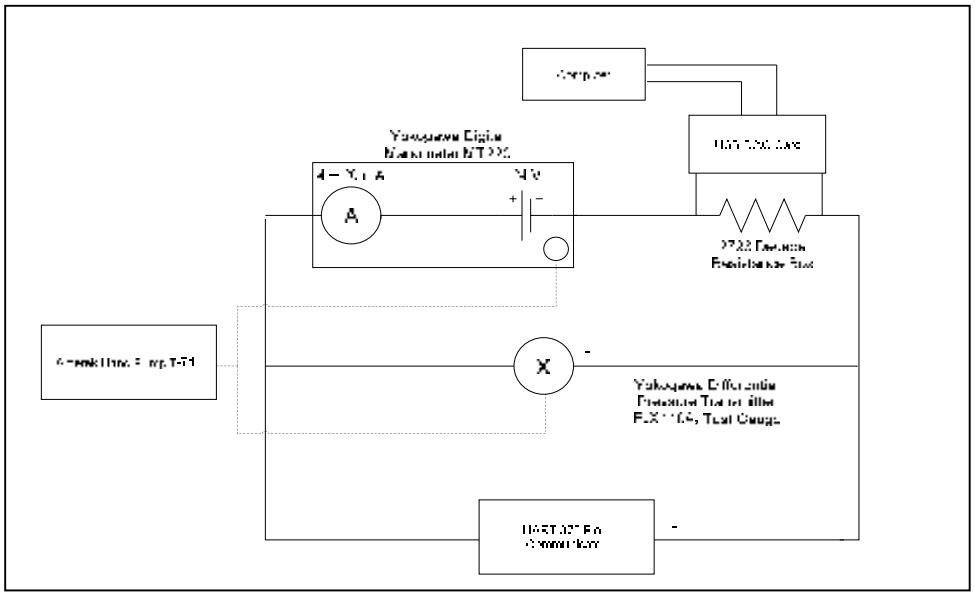

Figure 3.1: Pressure Instrument diagram

3.1.2 Advantech USB-4716 Data Acquisition Module (DAQ)

3.1.2.1 Advantech USB-471 Installation.

It is recommended to install the software driver before install the USB-4716 module into system to guarantee a smooth installation process. The 32-bit DLL driver Setup program for the USB-4716 module is included on the companion CD-ROM that is shipped with module package.

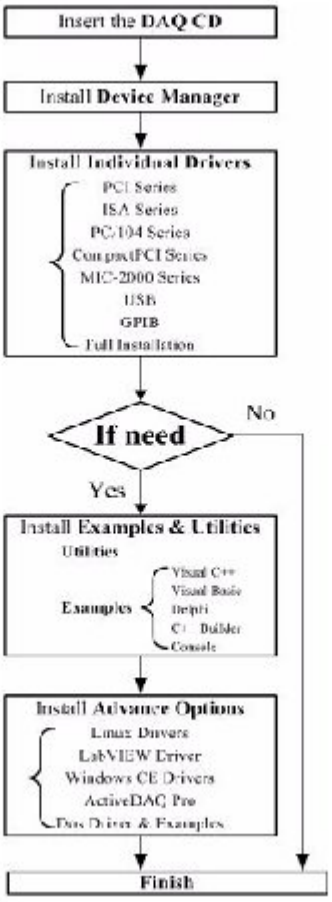

Figure 3.2: DAQ Installation Flow Graph

3.1.2.2 DAQ Pin Assignments

USB-4716 is equipped with plug-in screw-terminal connectors that facilitate connection to the module without terminal boards or cables. This DAQ Module has 10-pin I/O connectors on USB-4716.